NORTH AMERICAN GEOLOGY.

THE publications of the Geological Surveys in the United States and in Canada are noteworthy for the exhaustive treatment, from an economic as well as from a scientific point of view, of the subjects dealt with. In dimensions, in type, and in wealth of illustration, the numerous volumes which are issued bear favourable comparison with works published elsewhere.

Reports of United States Geological Survey.

Attention was called in NATURE of June 22, 1899, to Parts ii. and v. of the "Eighteenth Annual Report of the U.S. Geological Survey." We have lately received Parts iii. and iv. of the same Report. Part iii. is a bulky volume of 861 pages, which relate almost wholly to economic geology. Mr. George F. Becker deals with the gold-fields of Southern Alaska, while Mr. J. E. Spurr and Mr. H. B. Goodrich contribute an elaborate report on the geology of the Yukon Gold District, in the same territory. To the last-named work special reference has already been made in NATURE (December 7, 1899, p. 124). The Yukon gold-field lies close to the British frontier; that of Southern Alaska, to which we now draw attention, fringes the coast from Sumdum Bay westward as far as Unalaska, the mines being partly on the mainland, partly on islands. Mr. Becker gives an account of the volcanic activity and changes of level which have affected the region. Volcanic eruptions have occurred in comparatively recent times, and the belt of activity seems to have existed since late Eocene or early Miocene times. The author describes the various eruptive rocks, and a few schistose rocks which appear to be altered eruptive rocks; he also contributes notes on glaciation. The ore-deposits occur in a belt which coincides with the planes of schistosity in the altered rocks, and it is considered that their origin is connected with eruptive phenomena. The minerals associated with the gold are quartz and pyrites, copper pyrites, galena, zinc-blende, &c. The author gives accounts of the mines, and of the placer deposits, and refers also to certain auriferous beach-deposits. At present the district is but imperfectly explored.

Mr. Bailey Willis reports on some coal-fields of Puget Sound, Washington. The coal-bearing formation (Puget group) is of Tertiary age; the lower beds being Eocene, while the upper beds may be Miocene. The prevailing rocks are sandstones, but the deposits vary from arkoses, consisting of slightly washed granite materials, to siliceous clays, and they contain much carbonaceous material and distinct coal-seams. These strata rest unconformably on metamorphic schists and limestones of Carboniferous and Jura-trias date, and they are in places overlain conformably by marine Miocene (Tejon) strata. Tertiary eruptive rocks of younger date are associated with the Puget group. They occur as dykes and flows in various forms of intruded and extruded igneous rocks. Glacial deposits extend over large areas. The Puget strata were deposited in marshes and shallow-water areas, and subsequently were subject to considerable disturbances which led to folding and over-thrust, followed by normal faulting. Variations in the quality of the coals is attributed to the pressure and movement which they have suffered. The coals range in character from lignites to what are termed bituminous lignites or steam coals, and bituminous coking coals.

The geology and mineral resources of the Judith Mountains of Montana, form the subject of a report by Mr. W. H. Weed and Mr. L. V. Pirsson. These mountains are one of the groups of the Great Plains of the North-west, the nearest peaks of the Rocky Mountains being thirty-five miles to the west. They rise like a great island above the plains to a height of about 2500 feet above this level platform, the most elevated peak being 6386 feet above the sea. Geologically the mountains have been formed by a number of independent, coalescing, dome-shaped uplifts, involving the sedimentary series from the Cambrian to Cretaceous, and they are penetrated by laccolitic and other intrusions of igneous rocks. It is remarkable that while the great series of sedimentary rocks is apparently conformable throughout, yet the earlier strata are steeply upturned along the flanks of the Rocky Mountains, and the disturbances die out eastwards over the area of the plains. No Permian or Trias sediments occur, and the region was probably a land-area during those periods. Descriptions are given of the Cambrian, Silurian, Devonian, Carboniferous, Jurassic and Cretaceous rocks, and of the numerous laccolitic intrusions which are all of acid type. Granites, syenites, diorites and nephelite-syenites are found, the latter being represented by rocks of phonolitic character. The ore-deposits (chiefly gold) and the Cretaceous coal are described.

Mr. Waldemar Lindgren furnishes an account of the mining districts of the Idaho basin and the Boise ridge, Idaho, with a report on the fossil plants of the Payette formation, by Mr. F. H. Knowlton. The region includes a portion of the lower Snake River Valley and adjacent mountains on the northern side, together with the entire drainage of the Payette, Boise, and Wood rivers. The Boise mountains attain elevations of over 7000 feet. The area consists largely of granite together with the "Snake River Tertiaries." These latter comprise early Neocene (Miocene) lake-beds, known as the Payette formation, with which are associated vast masses of basalts and rhyolites; and later Neocene (Pliocene) deposits together with the Snake River basalts. Sands and gravels of Pleistocene age also occur. Gold occurs in the granitic rocks or associated dykes and veins, and in placer deposits. Monazite is found in the sands of the lake deposits, and there is no doubt that it forms one of the original constituents of the granite of the Idaho basin. This mineral, which is a phosphate of the cerium metals and thorium, yields products of economic value in the preparation of incandescent gas lights of the Welsbach and other burners. Silver-ores also occur in the region.

A preliminary report on the mining industries of the Telluride Quadrangle, Colorado, is contributed by Mr. C. W. Purington. This is a region of striking topographical features, the mountains rise to over 14,000 feet, while some of the streams have cut precipitous channels in the mountain cirques or basins to a depth of 7500 feet. Telluride, a town of about 1500 inhabitants, is in the heart of the mining district. The first prospectors entered the region about twenty-five years ago, and the district has made a steadily increasing output from its discovery to the present time. As remarked by the author, it has been the history of many ore-producing regions that much more money has been expended in the mining (and we might add financial) operations than has been extracted from the ore taken out. The Telluride district is said to be emphatically one where the money value, represented by the labour and capital expended, has not equalled or even approached in amount the product of the mines in the precious metals. The lesson that is taught is that conservatism in mining is poor policy, and that new methods and devices to meet new conditions, for which no rules can be laid down, are necessary for the successful production of ore in newly exploited areas. The district is composed of nearly flat sedimentary beds, which rest on Archæan and extend in geological age from the Trias to the Tertiary. This vast series has been in places tilted up, deformed, injected and broken through by igneous rocks, of Tertiary or Post-Tertiary age.

The ridges of the mountains present exceedingly irregular, sharply cut and jagged lines, whose sharp gaps are generally the result of the more rapid weathering and wearing down of metalliferous veins and zones of mineralised rock. Such zones usually have most brilliant colours—red, white and yellow—and are visible across country for a distance of twenty miles. With regard to the scenery in general, it is remarked that the beauty of form and colouring is unsurpassed in the mountain regions of the world. The metalliferous portions of the rocks are thus largely exposed to view, and their origin is attributed to the subterranean tract from which the igneous rocks have come; surface waters having descended through fissures to the horizon of the heated magma, and having subsequently ascended heavily charged with mineral matter. The vein-filling is considered to be later than the newest lavas exposed in the region. The vein-deposits are valued chiefly for the gold and silver, while much gold in a finely divided state occurs in placer deposits. It is noteworthy that none of the tellurides or other possible rare compounds of gold occur in the area, so far as the present investigation has been able to determine. No silver-ore occurs which does not contain, in the free state, more or less gold; while the galena, considered as an ore of silver, is merely the gangue or mechanical matrix of gold.

Part iv. of the "Eighteenth Annual Report" deals entirely with hydrography. It is a huge volume of 756 pages, comprising (1) Report on the progress of stream measurements for 1896, by A. P. Davis; (2) The water resources of Indiana and Ohio, by F. Leverett; (3) New developments in well-boring and irrigation in South Dakota, by N. H. Darton; and (4) Water storage and construction of dams, by J. D. Schuyler. Among the matters discussed is the temperature of the deeper artesian waters in the Dakota basin.

We have received also Parts i., iv. and vi. of the "Nineteenth Annual Report for 1897-8," and portions of Part ii. Part i. comprises the report of the director, Mr. Charles D. Walcott, and it includes observations on triangulation and spirit-levelling.

Part ii., which includes papers chiefly of a theoretical nature, contains an elaborate report on the principles and conditions of the movements of ground-water, by Mr. F. H. King. The author deals with the water-holding capacity of natural soils, the depth to which ground-water penetrates, and its general movements. Movements are due to barometric pressure and to thermal agencies, to crust deformation and to rock consolidation. The original water laid down with sediments is considered as well as the subsequent capillary movements of ground-water. Interesting results are given of experimental investigations regarding the flow of water and kerosene through sand, sandstone, wire-gauze, &c. ; and of the influence of the form, diameter and arrangement of soil and sand-grains on the amount of flow. An important record is given of the effect of the pumping of one well on another 1133 feet distant. Both wells were sunk in sandstone to a depth of about seventy feet. When pumping at the rate of about seventy-five gallons per minute from one well, a fall of water was detected in the other after the lapse of one minute and forty-five seconds. The pump was worked for ten minutes, and the fall of water in the second well continued for nearly fifteen minutes.

The article by Mr. King is followed by one on the theoretical investigation of the motion of ground-waters, by Mr. Charles S. Slichter.

An elaborate memoir on the Cretaceous formation of the Black Hills (Rocky Mountains), as indicated by the fossil plants, is communicated by Mr. Lester F. Ward, who has had the assistance of Messrs. W. P. Jenney, W. M. Fontaine and F. H. Knowlton. The forms described include a number of silicified Cycadean trunks, Conifers, Ferns and Equisetaceæ, also Dicotyledons belonging to the beech, oak, elm, mulberry and soapberry families. The work is illustrated by over a hundred plates, including one of Cycadean trunks from the Purbeck beds of the Isle of Portland, England, belonging to the U.S. National Museum.

Part iv., a volume of 814 pages, deals with hydrography : it contains a report, by Mr. F. H. Newell, on stream measurements ; and an account, by Mr. Edward Orton, of the Rock waters of Ohio. The knowledge of the Ohio waters is mainly due to the boring operations in search of oil and gas. Mr. N. H. Darton furnished a preliminary report on the geology and water resources of part of Nebraska. Several illustrations are given of tors or outstanding masses of sandstone which, from being locally hardened, have withstood the effects of denudation. Other instances of fantastic weathering, seen in the "Chimney Rock" and "Toadstool Park," are effectively shown in plates.

Part vi. (in two volumes) contains an account of the mineral resources of the United States. In the first volume, the metallic products, coal and coke are dealt with ; in the second volume, petroleum, natural gas, stone, clays, cement, precious stones, phosphates, mineral paints, &c. There are also notes on the mineral resources of Hawaii, and of the Philippine Islands.

Monographs of United States Geological Survey.

The twenty-ninth volume of the Monographs of the United States Geological Survey is a large work of 790 pages, on the geology of Old Hampshire county, Massachusetts, by Professor Benjamin K. Emerson. It is an elaborate memoir embodying personal observations which have extended over more than a quarter of a century ; and it deals with a great variety of formations—Algonkian, Cambrian, Silurian, Devonian, Triassic and Pleistocene—also with various eruptive rocks, and their many economic products. In the Algonkian series there are gneisses often granitoid, and others yielding much graphite, likewise magnesian limestone. Of Cambrian age are various gneisses and associated schists and quartzite. A detailed description is given of the granitoid gneiss of Monson, which is extensively quarried, the yearly output being from twenty to thirty thousand tons. The author draws attention to a remarkable tendency to expansion which has been stored up in the gneiss, causing blocks to elongate when they are quarried. In the same way the expansion causes the horizontal sheets of the rock to rise, often quite suddenly, in considerable anticlines, with the arch as much as fifty feet long and the rise three or four inches. These anticlines form sometimes with explosive violence, throwing large fragments of the rock more than two feet from their original position. Evidently the rock has an elastic stress which expresses itself in expansion when the surrounding masses are removed.[1]

Among the rocks classed as Lower and Upper Silurian are sericite-schists, amphibolites and serpentines, of which petrographical descriptions are given. Not the least interesting feature in the geology is the great magnetite-emery bed which lies along the junction of hornblende-schist and sericite-schist, and was discovered in 1864. The emery is distinguished from corundum (pure anhydrous alumina) which also occurs, and is regarded as an aluminate of iron. A full account of this mineral vein is given.

When we come to the Devonian rocks we still find a series highly altered, comprising in the main quartzite, and various schists, together with limestones. The rocks appear to rest conformably on, and, indeed, to pass into what are called Upper Silurian argillites ; nevertheless, the fossils, or rather impressions of them, which were obtained in the rocks, seem to be of upper Devonian type. Prof. J. M. Clarke remarks that they "are so distorted, obscure, and closely packed together, that a little imagination can construe them into species of all sorts of ages" ; but he feels "reasonably secure" about a few, among which is a large spirifer, like *Spirifera disjuncta*. Workers among the Devonian rocks in parts of Devon and Cornwall would feel sympathy with the difficulties of accurate identification, and suspend judgment about the local relations of Devonian and Silurian. In a general chapter on amphibolites the author states that he has assigned most of them with more or less confidence to the list of altered sedimentary rocks. Passing on to the eruptive rocks, he describes various granites, aplite, quartz-gabbro, tonalite or quartz-diorite, diorite, diabase, and cortlandite (hornblende-pyroxene-biotite-peridotite).

The Triassic rocks comprise a series of sandstones, conglomerates and red shales, together with diabases. The shales contain impressions of salt-crystals, and among the conglomerates the author finds evidence which suggests the former presence of shore-ice. Most interesting are the observations on the preservation of reptilian foot-prints and rain-drops which occur in sandstones that rest on the broad sheets of trap. It is thought that the iron set free from the decomposing lavas below permeated the sediments and favoured the preservation of the tracks ; it is also suggested that the heat of these great trap-sheets may have promoted rapid consolidation of the sand-layers by which they were quickly covered. In a few notes on the "Recent Progress in Ichnology," Mr. C. H. Hitchcock gives a list of the Ichnozoa of the Trias, including one marsupial, and many birds, dinosaurs, reptiles, batrachians, arthropods and mollusca.

In the account of Pleistocene phenomena we have references to Pre-Glacial drainage and erosion, descriptions of glacial lakes, and minor grooves and notches, and particular accounts of the till and various other drifts. The author remarks on the fragments worn by the agency of land-ice "into the peculiar shapes so characteristic of glacial accumulations, three- or four-sided forms, with irregular ends more or less elongate as the rock was more or less schistose, the sides flat or broadly convex, joined by rounded edges and scratched in various directions" ; and he adds that "These peculiar forms, called by the Germans *dreikantner*, are as characteristic of the till as graptolites of the Silurian." Numerous sections are given of glacial deposits, many of which remind us of the drifts so well exposed on the coasts of Norfolk and Suffolk, which exhibit similar structures and contortions. The Pleistocene beetles are described by Mr. S. H. Scudder. The volume, which is well illustrated, concludes with a chronological list of publications on the district, the earliest of which is a reference to an ancient catalogue (1734) of objects of natural history formed in New England, by John Winthrop, F.R.S.

Monograph No. 31 contains an account of the geology of the Aspen mining district, Colorado, by Mr. Josiah E. Spurr, and it is accompanied by a large folio atlas of maps and sections.

In an introduction, Mr. S. F. Emmons points out that Aspen is one of the most picturesquely situated mining towns of the Rocky Mountain region ; and that its great mineral wealth lies in a narrow belt of Palæozoic rocks, which are steeply upturned against granite, and broken in the most complicated manner by a network of faults.

[1] See also A. Strahan, on "Explosive Slickensides," *Geol. Mag.* for 1887.

The mines of Aspen were mainly discovered and opened by men whose most recent mining experience had been at Leadville, where the silver-ores were found principally at or near the contact of limestone, with overlying sheets of porphyry. The ores consist chiefly of lead and zinc sulphides, carrying silver, with a gangue of barytes, quartz and dolomite. Rich shoots of ore occur chiefly at the intersection of two or more faults, and the theory is advanced that while the minerals were deposited by hot waters, the solutions ascending along one of these channels were precipitated by solutions which circulated along the other.

The fundamental rock in the district is a granite, and this is overlaid by Cambrian, Silurian, Devonian, Carboniferous, Juratrias and Cretaceous. The Cambrian and Silurian formations are comparatively thin, and they consist largely of dolomitic sandstones and shales. The Devonian beds, which are very variable in character, comprise limestones and calciferous sandstones of no great thickness, and they are characterised by the presence of fishes of Devonian type. The Carboniferous and also the Secondary formations attain a great thickness. Into these strata, probably in Cretaceous times, there were intruded dykes of quartz-porphyry and diorite-porphyry. Great physical disturbances took place, accompanied by distinct systems of faults, some developed before, others after the deposition of the ores. In the author's opinion some faults have developed almost entirely in Post-Glacial times, the evidence resting partly on the preservation of scarps with slickensided fault-surfaces. He believes also that in many cases the fault-movement is going on at the present day. Since the beginning of the great disturbances, about 15,000 feet of sedimentary rocks have been removed by denudation; in later times by glacial action. A general ice-sheet at one time covered the whole of the Aspen district, leaving evidence of its presence in the rounded and fluted forms into which the hill-tops are carved, and in deposits of morainic material. When the ice-sheet shrank to smaller dimensions, there resulted local glaciers which followed the course of pre-existing valleys, and carved them into their present forms. At this period temporary lakes were formed by the damming up of glacial waters.

The author has given considerable attention to the subject of dolomitisation. He remarks that along the channels afforded by faults, hot spring-waters containing carbonate of magnesia rose and produced the dolomitisation of the limestone. Zones in the limestone following watercourses which are parallel to the bedding, or which cut across it, are locally altered to dolomite. There is evidence also of an earlier period of such chemical interchange, some of the Silurian and Carboniferous sediments having been early converted into dolomite by the action of magnesium salts contained in the waters of a great lake or inland sea, and in which they were concentrated by evaporation. These earlier dolomites are continuous over wide areas, with an almost uniform chemical composition.

Maryland Geological Survey.

Under the vigorous direction of the State Geologist, Prof. W. Bullock Clark, the Maryland Geological Survey has just issued its third volume; one of a series which in type and illustration is one of the most excellent of all the geological reports published in the United States. The present volume deals wholly with questions of economic geology treated from a scientific as well as a practical point of view. It is, in fact, a manual on road-materials and road-construction. The dependence of the highways upon the surface configuration of the land, and the bearing of the distribution of temperature and rainfall are pointed out. Attention is rightly paid to the relationship between the stony structure of the ground and the roads. The questions of construction and repair, and the qualities of road-metals are dealt with in detail, and the construction of sample roads is described. Various administrative matters are also dealt with. Illustrations are given of the method of road-making since early times; there are numerous photographic illustrations of types of roads formed of different materials, including types of bad roads in Maryland; and there are photo-micrographs of rock-sections of road-material.

Geology of Indiana.

A bulky volume of 1741 octavo pages forms the "Twenty-third Annual Report of the Department of Geology and Natural Resources for the State of Indiana," under the direction of Mr. W. S. Blatchley, State Geologist. It comprises the result of a careful survey of the coal area of Indiana, giving full details of the physical features and stratigraphy, of the mines and method of mining, with analyses of the coal. The work is profusely illustrated with maps and sections, and not the least interesting are the sections of faults and disturbances and evidences of irregularities in the coal-seams due to local thickening by disturbance, or to original deposition, or to erosion in Carboniferous or later periods. A report is made on the natural gas which occurs in the Trenton limestone, and is sealed up beneath the Utica shale. The first boring was made in 1884, and the gas was tapped at a depth of about 1100 feet. The Trenton limestone was proved to be both the source and the reservoir of the gas.

Geological Survey of Canada.

The "Annual Report of the Geological Survey of Canada for the year 1897 (1899)" has just reached us. It is a composite volume, containing six individual reports separately paged, but all indexed together with special references to each. As the progress of the survey has been noticed already in NATURE, when dealing with the Annual Summary Reports of the director, Dr. G. M. Dawson, it will suffice to call attention to this important volume which contains detailed accounts of Archæan, Palæozoic and Pleistocene deposits, with full descriptions of the economic products. There is a special report on the mineral resources of New Brunswick, by Mr. L. W. Bailey, and another on mineral statistics and mines, by Mr. E. D. Ingall. The volume is illustrated by a number of maps and plates. One of the most effective views is that of the Devil's Rapids on Chandière river, Quebec. It illustrates a report on the surface geology and auriferous deposits of South-eastern Quebec, by Mr. R. Chalmers.

ELECTRO-CULTURE.

THE results obtained by culture under the influence of electric light are fairly well known, and the growing of lettuce for salads, in spacious greenhouses with the aid of electric light, is already a profitable industrial pursuit in the United States (near Chicago and elsewhere). However, the use of electric currents for stimulating vegetation, although it was studied more than fifty years ago (by Ross, in 1844–46; continued by Forster, Sheppard, Fichtner, &c.), still remains unsettled. A communication upon this subject, made by a Russian engineer, V. A. Tyurin, before the St. Petersburg Electro-Technical Society, contains some welcome information upon the work done in this direction in Russia by M. Spyeshneff and M. Kravkoff. The former experimented a few years ago on three different lines. Repeating well-known experiments on electrified seeds, he ascertained once more that such seeds germinated more rapidly, a nd gave better fruit and better crops (from two and a half to six times higher), than seeds that had not been submitted to preliminary electrification. Repeating next the experiments of Ross—that is, burying in the soil one copper and one zinc plate, placed vertically and connected by a wire, he found that potatoes and roots grown in the electrified space gave crops three times heavier than those which were grown close by on a test plot; the carrots attained a quite unusual size, of from ten to twelve inches in diameter. Spyeshneff's third series of experiments was more original. He planted on his experimental plot, about ten yards apart, wooden posts provided at their tops with metallic aigrettes connected together by wires, so as to cultivate his plants under a sort of network of wires. He obtained some striking results, one of which was that the growth and the ripening of barley were accelerated by twelve days. Quite recently M. Kravkoff undertook a series of laboratory experiments upon boxes of soil submitted to electric currents. The temperature of the soil was raised by these currents; its moisture decreased first, but began to increase after a course of three weeks (the same increase of moisture was also noticed by Fichtner); and finally, the amount of vegetable matter in the soil was increased by the electric currents. With what is now known upon the influence of micro-organisms upon vegetation, further research on similar lines is most desirable and very promising.

SCIENTIFIC SERIALS.

THE *Journal of the Royal Microscopical Society* for April contains the President's Annual Address, the last instalment of his valuable series of addresses on the mathematics of the construction of microscopic lenses. In this address, Mr. E. M. Nelson devotes himself to the aplanatic immersion front and the Huyghenian eye-piece, and deals with the errors of this lens, viz. chromatism, curvature of image, distortion, and astigmatism.